

AD-A191 003

CONSTRUCTION OF PIERCED HEMISPHERICAL GRIDS(U)  
PITTSBURGH UNIV PA SURFACE SCIENCE CENTER P A TAYLOR  
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Contract N00014-82-K-0280

Task No. NR413E001

TECHNICAL REPORT NO. 16

Construction of Pierced Hemispherical Grids

by

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Prepared for Publication in

Journal of Vacuum Science and Technology A

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28 January 1988

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1. REPORT NUMBER 16	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Construction of Pierced Hemispherical Grids		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Patrick A. Taylor		8. CONTRACT OR GRANT NUMBER(s) N00014-82-K-0280
9. PERFORMING ORGANIZATION NAME AND ADDRESS Surface Science Center, Chemistry Department, University of Pittsburgh, Pittsburgh, PA 15260		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 1/29/88
		13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Electron Optics Ion Optics Grids, fabrication		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In this report we describe an easy way to construct hemispherical grids and a procedure to cut holes of any shape through the grids without distorting the grid itself. The grid material may be either stainless steel or tungsten. The grid is made from a high transparency 100x100 screen mesh woven with 0.001" diameter wire. The grids are shaped and spot welded onto stainless steel annular rings. Once attached to the ring, holes of any shape may be pierced through the grid.		

date submitted: Jan. 15, 1988  
submitted to: J. Vac. Sci. Tech A  
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# Construction of Pierced Hemispherical Grids.

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## **Construction of Pierced Hemispherical Grids**

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### **A. Introduction**

In this report we describe an easy way to construct hemispherical grids and a procedure to cut holes of any shape through the grids without distorting the grid itself. The grid material may be either stainless steel or tungsten. The grid is made from a high transparency 100x100 screen mesh woven with 0.001" diameter wire <sup>1</sup>. The grids are shaped and spot welded onto stainless steel annular rings. Once attached to the ring, holes of any shape may be pierced thorough the grid.

### **B. Construction of Grids**

The procedure used to shape the hemispherical grids is similar to that described by Shaw and Bennett <sup>2</sup> and by Koch <sup>3</sup>. The construction of a hemispherical grid, described below, can serve as a model for any shaped grid.

The grid is pressure formed into a hemisphere. This is accomplished by pressing the tungsten mesh (W) between a brass mandrel (M) and an annular stainless steel plate (P),

as shown in Fig. 1. Brass is used for the mandrel because of its poor spot welding abilities. The whole assembly is held together with machine clamps (A) as the tungsten mesh is tacked in ~10 places to the stainless steel plate with a spot welder (S) (spot weld energy: 40 watt seconds). Once the grid is tacked onto the plate, the grid and plate (W,P) are removed from the mandrel (M). The excess mesh is cut off and the wire ends are spot welded to the steel plate (spot weld energy: 25 watt seconds).

### C. Piercing the Grids

To construct the holes, the center point of the hole is located and marked with a metal punch on the brass mandrel (M). The shape of the hole is then scratched into the brass with a scribe. The stainless steel plate (P) with the hemispherical grid is clamped to the mandrel in the proper orientation with respect to the hole. The entire assembly is placed in an aqueous salt solution (~100g NaCl in 2l) under a microscope, as shown in Fig. 2. The plate-mandrel (P-M) assembly acts as one spot welder electrode ( $S_1$ ). The second electrode is constructed from 0.020" tungsten wire, with one end of the wire ground or cut to a point of approximately twice the mesh wire diameter; the other end is attached to a long piece of copper braid or wire, which

in turn is connected to the spot welder. This assembly allows the second electrode ( $S_2$ ) to be maneuverable.

While viewing under the microscope, the point of the second electrode is placed on a wire of the tungsten mesh which intercepts the scribed guideline on the mandrel, as shown in the inset of Fig. 2. An electrical pulse of sufficient energy is used to cut the tungsten mesh (energy: 25 watt seconds). In this fashion the hole is cut out using the scribed guideline as a template to shape the hole. The salt solution is used to protect the brass mandrel from the heat produced during the cutting and may contribute to the electrical contact between the electrodes, the mesh, and the mandrel. Before removing the grid from the mandrel, the edges of the hole should be checked for any wires accidentally spot welded to the mandrel. Cutting the hole in air causes severe pitting of the brass mandrel and makes its subsequent use difficult.

Depending on the pressure applied between the wire mesh and the mandrel by the tip of electrode  $S_2$ , the number of wires cut may vary. Usually the wire cut by the electrical arc is not limited to the point of contact, and the wires are cut up to the point where they intercept a perpendicular wire.

Once the hemispherical grid is removed from the mandrel some relaxation of the grid occurs, which distorts the sphericity. This very slight distortion from perfect



sphericity causes no discernible problems in the electrical properties of the grids. If one is concerned, however, electroplating or a heat treatment prior to piercing the grid may prevent this relaxation. If heat treatment is the preferred route, caution must be taken to use a vacuum compatible material for the mandrel used during the heat treatment (brass may not be used).

#### **D. Acknowledgements**

The procedures described here represent the accumulated knowledge passed down through our laboratory. The help and experience of Dr. Craig Klauber and Dr. Mark Alvey greatly contributed to the development of these techniques. The helpful comments on preparing this manuscript by Professor J.T. Yates, Jr. are also appreciated. The support of this work by the Office of Naval Research is also acknowledged.

#### **E. References**

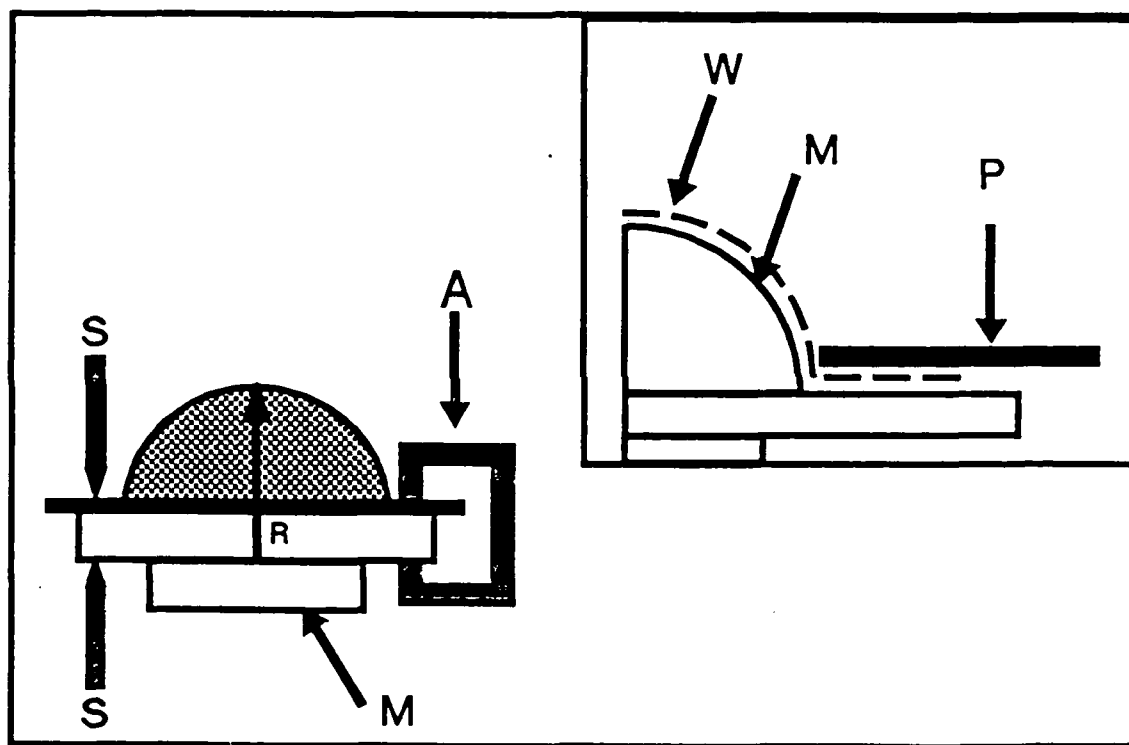
- 1 Wire weaves for grids may be obtained from Unique Wire Weaving Co., Inc., 762 Ramsey Avenue, Hillside, N.J. 07205.
- 2 D.A. Shaw and D.A. Bennett, Review Sci. Instrum., 43 (1972) 1706.
- 3 J. Koch, Review Sci. Instrum., 45 (1974) 1212.

### Figure Captions

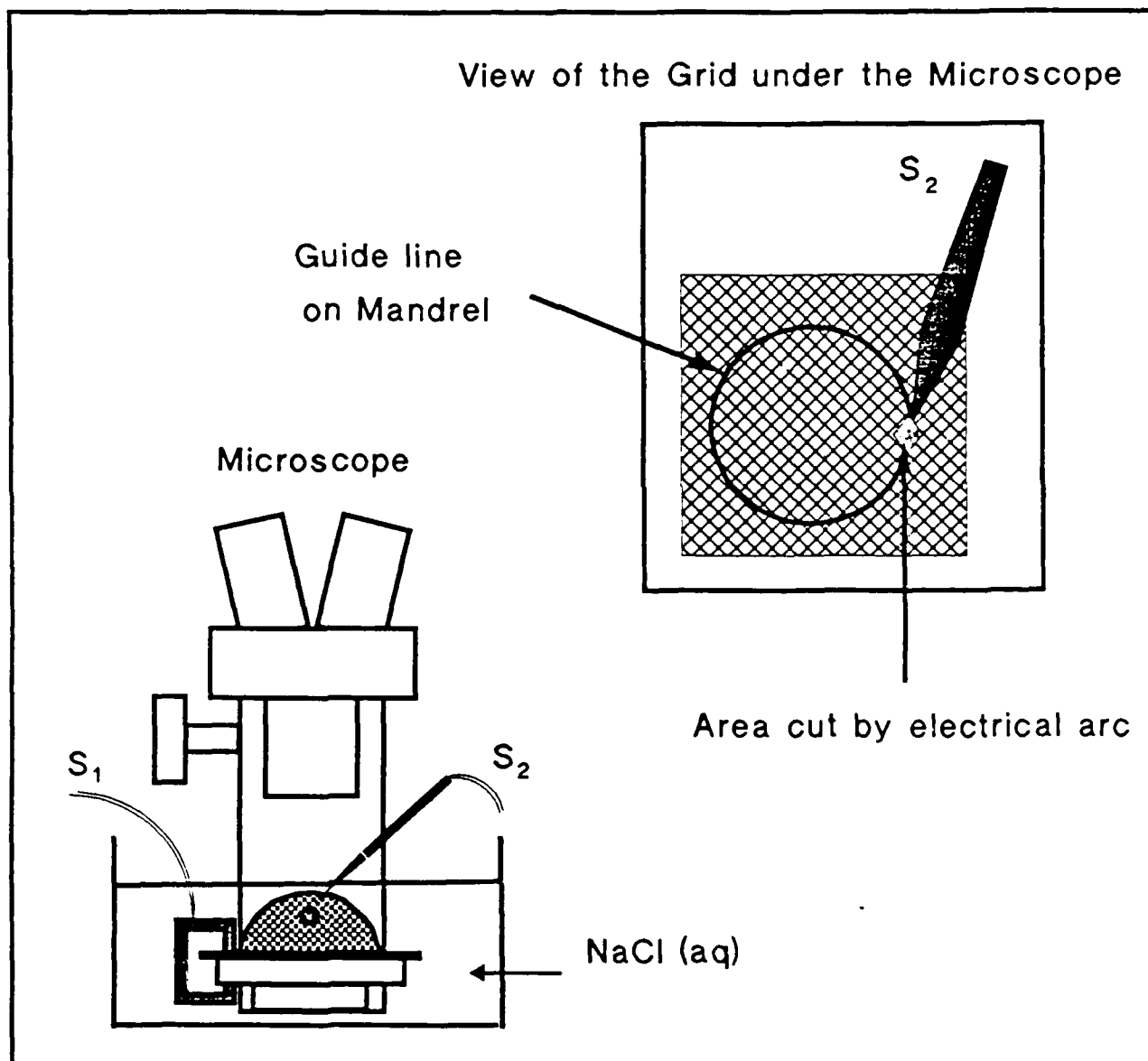
Figure 1. The pressure forming of hemispherical grids. Key:  
A-machine clamp; P-stainless steel annular ring  
plate; R-radius of hemispherical grid; S-spot  
welder; W-tungsten wire mesh.

Figure 2. Assembly used to cut holes in hemispherical  
tungsten grids under an aqueous NaCl solution  
(energy: 25 watt seconds). Key:  $S_1$ -fixed spot  
welder electrode (mandrel-grid);  $S_2$ -movable spot  
welder electrode (tungsten needle).

# Construction of Hemispherical Grid



# Assembly for Piercing Holes in Grid



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